Bridging The Gap

"Bridging the Gap" is an example of one elementary-level instructional model that was developed by practicing teachers to reflect the philosophy of the Nebraska Mathematics/Science Frameworks.

A reduced scale model is used on the inside pages to demonstrate how the Mathematics/Science Frameworks addresses the issues of multiculturalism, connections, inquiry/problem solving, and assessment by showcasing one instructional model.

Bridging the Gap — Elementary Level #1

Materials/Supplies:

Activity sheet/ purchase order
Clay
Straight pins or small nails
String
Tongue depressors
Straws
Thread
Masking tape
Toothpicks

Topic Strands:
Interdependence
Spatial Relationships/Geometric Topics
Data Analysis

Conceptual Threads:
Systems & Interactions
Problem Solving
Problem Solving

Process Skills of Learning:
Communicating, Connecting, Measuring, Modeling, Problem Solving, Predicting, Questioning, Researching, Reasoning

Why (Purpose/Objective of the lesson):
To explore the use of appropriate tools and their practical application in building selected objects. By constructing a bridge model using geometric shapes, students are better able to develop and apply problem–solving strategies.

How (Procedure of the lesson):

1. Begin by telling the story of Emily Warren Roebling who faced the challeng completing the construction of the Brooklyn Bridge after her engineer husb became ill. In those days, women were not welcome to enter scientific/mat careers. She overcame great odds to successfully complete the project and v respect of fellow engineers.

2. Present challenge to design a bridge. Sketch proposed bridge and estimate using the following specifications:

   a. Students work in bridge–building companies (small groups) of three to students, with every company having an equal number of members if p

   b. The bridge must span the distance between two desks that are placed s created between them. (With fifth graders, this gap normally measures centimeters).

   c. Only the supply materials listed on the purchase order may be used to the bridge. Students are given a list of these materials prior to sketchin bridge design.

   d. Students are allowed to measure the cement prior to determining the ar they want to purchase.

   e. Students are allowed to test the strength of different geometric shapes a supplies prior to sketching their bridge design.

   f. Bridge constructions are evaluated on their capacity to hold weight. De of bridge platform may need to provide for applying weights dependin format chosen to test this capacity. Students need to know (how their b be assessed) prior to designing and building their bridges.

   g. Using the purchase order sheet, the group will determine needed mater calculate the cost of constructing their bridge.

Bridging the Gap

Connections:

- Uses measurement, scale and structure, geometric shapes, and money to connect mathematics to the real world.
- Students make the science connection through the construction of a bridge and by comparing it to the structure of skeletal systems.
- Read and discuss *Emily's Triumph*.
- Illustration of bridge design provides an art connection.
- Community connection is provided by inviting an engineer or construction worker to visit the class.

Inquiry/Problem Solvin

- The students are:
  - Focusing on exploration.
  - Constructing models.
  - Developing problem–solving str
  - Challenged to design a bridge given specifications.
  - Applying knowledge gained to an improved bridge design.

lementary Level #1

Supply Substitute	Cost/Amount
	0,000/100 grams
	,000/each
	0,000/decimeter

Multiculturalism:

- Gender roles are explored by focusing on the historical role of Emily Warren Roebling in *Emily's Triumph*.
- Students interact in bridge–building companies (e.g., cooperative groups).
- Bridge–building problem–solving strategies/designs are shared.
- Data collection, its representation, and interpretation allows different perspectives to be explored.
- Student research on history of bridges provides for local ties as well as global perspectives.

Bridging the Gap *Elementary Level #1*

Additional Activities (Extensions):

1. Invite engineer or construction worker to review student bridges and discuss bid and actual bridge costs.
2. Students can make the connection between the structure of a bridge [illegible]d the structure of the skeletal system. The cylindrical shape of straws is similar to [illegible]indrical shape of leg bones which allows for optimum weight–bearing capacity.
3. Read and discuss "Emily's Triumph" (Silver-Burc' [illegible], Grade 5), which gives the complete story of Emily Warren Roebling.
4. Research the history/functions of local bridges as well as bridges throughout the worl

Possible Assessment Ideas:

Outcome: Through problem solving and group cooperation, students connect their understanding of the strength of geometric shapes and apply it to bridge construction.

Task: Design and build a bridge to meet specifications of span strength and effectiveness.

Criteria	Proficient	Basic	In Progress
Problem Solving	All specifications met completely; as obstacles arise, group develops alternate plans that improve the bridge.	Met most but not all specifications; as obstacles arise, group develops alternate plans without improving the bridge.	Met few, if any, of the specifications; as obstacles arise, the group ignores or minimumly addresses the problem.
Utilization of purchase order	Accurately predicts amount of needed supplies; uses materials in most functional ways; accurately completes computation tasks on purchase.	Plan does not reflect actual purchasing; materials used in functional ways; computation has little or no errors on purchase order.	Predicts materials in unreasonable quantities; uses materials ineffectively; inaccurate/incomplete computation tasks on purchase order.
Bridge Strength	Strength of bridge exceeds weight requirement.	Strength of bridge meets weight requirement.	Strength of bridge does not meet weight requirement.
Cooperation within a group	Consistently and actively shares tasks/roles; consistently encourages others; acceptance and discussion of other's ideas; project completed.	Inconsistent sharing of tasks/roles (though observable most of the time); some encouragement of others; sporadic sharing and discussing of ideas; completes the project.	Monopolizes or uninvolved; consistent put–downs and no productive arguments; little or no encouragement; project not completed.

Assessment:

- Authentic task with rubric is included.

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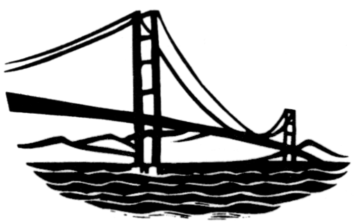
Bridging the Gap *Elementary Level #1*

Materials/Supplies:
Activity sheet/
purchase order
Clay
Straight pins or small nails
String
Tongue depressors
Straws
Thread
Masking tape
Toothpicks



Topic Strands:
Interdependence
Spatial Relationships/Geometric Topics
Data Analysis

Conceptual Threads:
Systems & Interactions
Problem Solving
Problem Solving

Process Skills of Learning:

Communicating	Connecting	Measuring	Modeling
Problem Solving	Predicting	Questioning	Researching
Reasoning			

Why (Purpose/Objective of the lesson):
To explore the use of appropriate tools and their practical application in building selected objects. By constructing a bridge model using geometric shapes, students are better able to develop and apply problem-solving strategies.

How (Procedure of the lesson):

1. Begin by telling the story of Emily Warren Roebling who faced the challenge of completing the construction of the Brooklyn Bridge after her engineer husband became ill. In those days, women were not welcome to enter scientific/mathematical careers. She overcame great odds to successfully complete the project and win the respect of fellow engineers.
2. Present challenge to design a bridge. Sketch proposed bridge and estimate its costs using the following specifications:
   a. Students work in bridge-building companies (small groups) of three to five students, with every company having an equal number of members if possible.
   b. The bridge must span the distance between two desks that are placed so a gap is created between them. (With fifth graders, this gap normally measures 30 centimeters).
   c. Only the supply materials listed on the purchase order may be used to construct the bridge. Students are given a list of these materials prior to sketching their bridge design.
   d. Students are allowed to measure the cement prior to determining the amount they want to purchase.
   e. Students are allowed to test the strength of different geometric shapes and supplies prior to sketching their bridge design.
   f. Bridge constructions are evaluated on their capacity to hold weight. Design/size of bridge platform may need to provide for applying weights depending on the format chosen to test this capacity. Students need to know (how their bridge will be assessed) prior to designing and building their bridges.

Bridging the Gap *Elementary Level #1*

   g. Using the purchase order sheet, the group will determine needed materials and calculate the cost of constructing their bridge.
3. Construct bridges.
   a. Share and evaluate bridge building problem-solving strategies/designs.
4. Estimate, then test strength of bridges.
5. Collect data on bridge strength. Present in graph form.
6. Students develop and test new construction plan based on what they have learned.
7. Debrief activity.
   a. Which materials created the strongest bridges?
   b. What construction ideas were used by the groups?
   c. What surprised the students most?
   d. List 3 things that could be done to improve each bridge.
   e. Describe geometric shapes used and compare their strength.

For Your Information (Background information for the lesson):
1. Suggested unit prices for bridge samples:
   a.

Supply	Supply Substitute	Cost/Amount
Cement	Clay	$50,000/100 grams
Rivets	Straight Pins	$1,000/each
Cable	String	$10,000/decimeter
Steel Beam	Tongue Depressors	$20,000/each
Guide Wire	Thread	$1,000/decimeter
Steel Girder	Straws	$10,000/each
Struts	Toothpicks	$5,000/each
Trussing	Masking Tape	$10,000/meter

2. Additional resources:
   a. *Tar Beach* by Faith Ringold. Also available on video.
   b. National Parks film on the St. Louis Arch.

Suggested Instructional Strategies:
Bridges are built in groups of 4-6 to allow for maximum idea generation and interaction.

Bridging the Gap *Elementary Level #1*

Additional Activities (Extensions):

1. Invite engineer or construction worker to review student bridges and discuss bid and actual bridge costs.
2. Students can make the connection between the structure of a bridge and the structure of the skeletal system. The cylindrical shape of straws is similar to cylindrical shape of leg bones which allows for optimum weight-bearing capacity.
3. Read and discuss "Emily's Triumph" (Silver-Burdett, Dream Chasers, Grade 5), which gives the complete story of Emily Warren Roebling.
4. Research the history/functions of local bridges as well as bridges throughout the world.

Possible Assessment Ideas:

Outcome: Through problem solving and group cooperation, students connect their understanding of the strength of geometric shapes and apply it to bridge construction.

Task: Design and build a bridge to meet specifications of span strength and effectiveness.

Criteria	Proficient	Basic	In Progress
Problem Solving	All specifications met completely; as obstacles arise, group develops alternate plans that improve the bridge.	Met most but not all specifications; as obstacles arise, group develops alternate plans without improving the bridge.	Met few, if any, of the specifications; as obstacles arise, the group ignores or minimumly addresses the problem.
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Cooperation within a group	Consistently and actively shares tasks/roles; consistently encourages others; acceptance and discussion of other's ideas; project completed.	Inconsistent sharing of tasks/roles (though observable most of the time); some encouragement of others; sporadic sharing and discussing of ideas; completes the project.	Monopolizes or uninvolved; consistent put-downs and no productive arguments; little or no encouragement; project not completed.

Sky High *Elementary Level #2*

Materials/Supplies:
Activity sheet
Science resource books (dealing with solar system)
Calculators
World map
Yarn

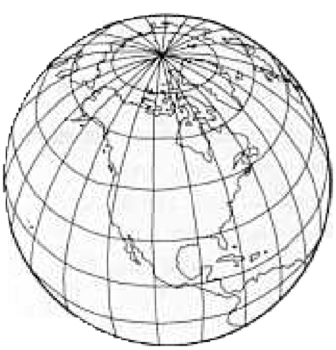
Topic Strands:
Universe
Measurement

Conceptual Threads:
Scale and Structure
Estimation

Process Skills of Learning:
Communicating
Interpreting Data
Problem Solving
Researching

Why (Purpose/Objective of the lesson):
To investigate relationships of distances in space and verify reasonableness of information.

How (Procedure of the lesson):
1. Prepare classroom with student chairs arranged like the seats in an airplane. (Ideas: Row and seat numbers on chairs; hand out seat assignments and boarding passes as students enter; play tape recording of pilot welcoming them—leave destination open ended).
2. Students pick a global destination and find the cost of a round trip at a rate of one cent per thousand miles.
3. Record students' global destination choices along with their reasons for selecting their destination. What would the students expect to see, hear, smell, touch, and taste once they arrive?
4. Have students map out their global destinations on a wall map by using a specific color of yarn for each continent. How many meters of yarn would we need if 1 cm = 1,000 miles?
5. Figure the distance of a light year.
6. Calculate the total cost of flying to all listed locations within our solar system.
7. Small groups of students then calculate the cost of flying to locations outside our solar system.
8. Students explain the strategy they used to find the cost of their trip.
9. Present Sky High activity sheet to students. Facilitate their investigation of the activity.
   a. Do students agree with information?
   b. Are the figures reasonable?
10. Share thinking/problem-solving strategies.
11. Facilitate students' work on additional activities.



For Your Information (Background information for the lesson):
1. Children's understanding of the size of the Earth and the universe gradually increases through their experiences with the sun, moon, and stars. These vast distances in space are made more meaningful to students through their own investigations.

Sky High Elementary Level #2

If the distance was 25 trillion miles (25,000,000,000,000) at a rate of 1¢ per 1000 miles, it would cost 25,000,000,000¢ or $250,000,000. To change pennies to dollars, divide by 100 by moving the decimal two places to the left or multiply by .01.

3. **Distances in Space** — A light year is approximately 5.878 trillion miles. Light travels at 186,282 miles/second. Distances are the average of perihelion (closest) and aphelion (farthest). It is recommended that students research these distances.

Object In Space	Closest approach to Earth	Mean Distance from Sun
Moon	238,857 miles	—
Sun	93,000,000 miles	—
Mercury	57,000,000 miles	35,800,000 miles
Venus	25,700,000 miles	67,200,000 miles
Mars	48,700,000 miles	141,600,000 miles
Jupiter	390,700,000 miles	483,600,000 miles
Saturn	762,700,000 miles	886,700,000 miles
Uranus	1,700,000,000 miles	1,783,200,000 miles
Neptune	—	2,794,200,000 miles
Pluto	—	5,900,000,000 miles
Chiron (Asteroid orbiting between Saturn and Uranus)	—	1,273,500,000 miles
Haley's Comet	1,652,300,000 miles	—

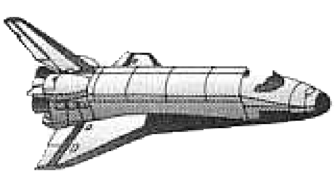
Object in Space	Closest approach to Earth
Alpha Centauri - nearest 3rd brightest star	4.3 light years or 25 trillion miles
Sirius - brightest star	8.8 light years or 50 trillion miles
Canopus - 2nd brightest star	100+ light years
Arcturus - 4th brightest star	36 light years
Vega - 5th brightest star	26 light years
Ring Nebula (in Lyra)	15,000 billion miles
Small and Large Magellanic Clouds	200,000 light years
Andromeda Galaxy - twin galaxy	2.2 million light years or 13 million, million, million miles
Quasars (at the limit of the known Universe)	7 billion to 13 billion light years

Sky High Elementary Level #2

4. NASA regional resource center in Lincoln has additional information and videotapes available. Phone: (402) 472-6302. See page J–2 of the original document for address.

Suggested Instructional Strategies:
The classroom is organized like the cabin of an airplane. Students work in small cooperative groups. Team teaching with Reading and/or Language Arts teacher is helpful.

Additional Activities (Extensions):
1. Investigate cost of one cent per 1,000 miles compared to available airline rates (e.g., airline newspaper ads, travel agent).
2. Explore and compare travel costs using various forms of transportation.
3. Examine undersea travel and compare to space travel: types of vehicles used, equipment needed, time involved, cost efficiency, and research purposes.
4. Have students work in groups to research a planet and create critters that could survive on their planet. Explain adaptations to class.
5. Multicultural Connection: encourage students to research scientists contributing to the space program (e.g., Maria Mitchell, Neil Armstrong, Hantaro Nagaoka, Benjamin Banneker, Valentina Tereshkova, Subrahmanyan Chandrasekhar, Nicolaus Copernicus, Galileo Galilei, Robert Goddard, Sir William Herschel, Johannes Kepler, Sir Isaac Newton, Sally Ride, or Carl Sagan).
6. Teacher reads *A Day of the Earthlings* by Eve Bunting.
    a. Stop and have the students predict what will happen next. Record predictions in student journals.
    b. Create a video tape of a commercial advertising a selected destination.
    c. Additional literature connections:
        "Close Up Look at Mars" from *Dreamchasers*, Silver Burdett-Ginn; and *The Magic School Bus, Lost in Space* by M. Cole.



7. Take a field trip to a planetarium, airport, travel agency or have a pilot, travel agent, and/or astronomer visit the classroom.
8. Create a travel poster and/or brochure.
9. Make a paper mache model of planets.

Possible Assessment Ideas:
1. Students' performance in additional activities section can be evaluated.
2. Reasonableness of findings. Is the cost calculated accurately? Can students clearly explain how they arrived at the cost?

c:pd_assm/addendum/August 18, 1995

Sky High *Elementary Level #2*

Possible Activity Sheet:
"If it cost one cent to ride 1,000 miles, a trip around the world would cost 25 cents. A trip to the moon would cost $240, and a trip to the sun, $930. But a trip to Alpha Centauri, the nearest star system, would cost $260 million." — Reader's Digest, October 1993

Do students agree with these figures?

Are the figures reasonable?

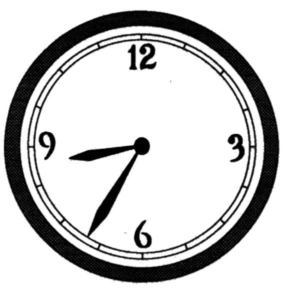
Students share their thinking/problem solving.

Students may extend this problem as they choose.

Tinkering With Time *Elementary Level #3*

Materials/Supplies:
Various kinds of clocks
screwdrivers (phillips & regular)

Various books such as: *The Grouchy Ladybug* by Eric Carle, *Clocks & More Clocks* by Pat Hutchins, and *Time to.* by Bruce McMillan



Topic Strands:
Force and Motion
Measurement
Measurement

Conceptual Threads:
Scale and Structure
Problem Solving
Technology

Process Skills of Learning:
Classifying
Problem Solving
Measuring
Predicting
Observing

Why (Purpose/Objective of the lesson):
To observe what makes a clock work. Explore and classify clock parts according to purpose and geometric shape.

How (Procedure of the lesson):
1. Read *The Grouchy Ladybug* by Eric Carle.
2. Discuss time and its role in students' lives.
3. Examine various clocks, such as digital, electric, and battery.
4. Classify clocks as a large group.
5. Draw a picture as a prediction of the inside of a clock.
6. Explore parts of clock. Rules: can't break clock, can't cut wire (teacher will cut). Look for geometric shapes and angles in the parts of the clock.
7. Draw picture of inner workings of the clock.
8. Compare and classify the parts of the clock.
9. Use the clock parts as non-standard tools to measure items in the classroom.
10. Measure clock parts with standards units of measure.

For Your Information (Background information for the lesson):
By taking the covers off and looking inside, you can see the way a machine works. Mechanical machines have working parts. Parts may be springs, cranks, gears, levers, wheels, etc.

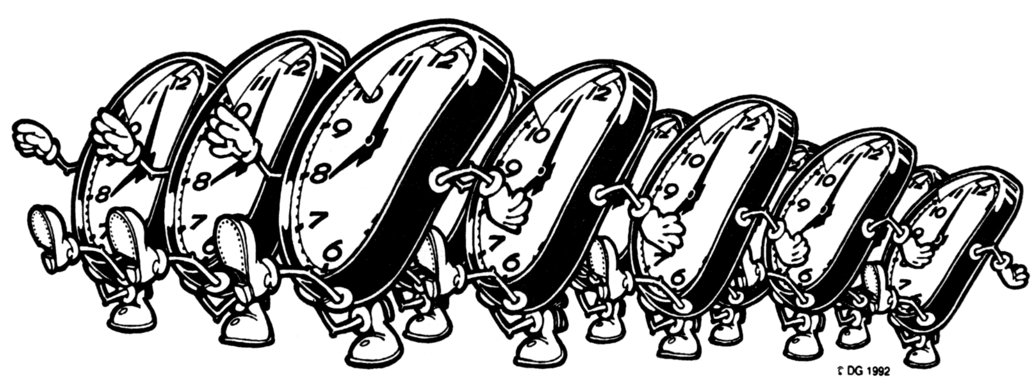
Suggested Instructional Strategies:
The students will work in small cooperative groups. All students will be involved in exploration and group discussion. Multigrade groups may be helpful in taking the clocks apart. Group discussion.

Additional Activities (Extensions):
1. Order the parts by size.
2. Which clock had more parts?
3. What made the sound in the machine?
4. Students bring other machines to take apart.
5. Weigh like parts on balance scale.

Tinkering With Time — Elementary Level #3

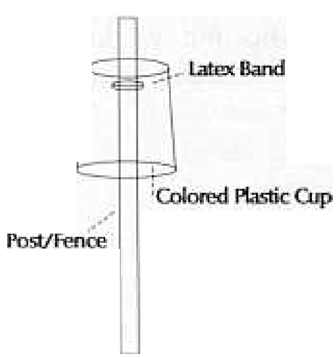
6. Tie into shadows, telling time, sundials, hourglass, egg timer, new moons, and various kinds of clocks as ways to tell time.
7. Read either or both of the following books to the students: *Clocks and More Clocks* by Pat Hutchins or *Time to...* by Bruce McMillan. Create a "Telling Time" book showing what students are doing at various times of the day.
8. Invite a repairperson to discuss clocks and other small machines.
9. Students can write word problems dealing with time.
10. Visit a jeweler or clock shop.
11. Research history of time and time in other cultures.
12. Put clocks back together.
13. Create a time-telling device.

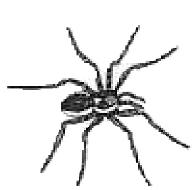
Possible Assessment Ideas:
Students will develop a classification system (i.e., chart, table, Venn diagram, dichotomous key) that will explain their groupings of clock parts. Teacher observes student interactions and watches for the following skills: variety of attributes used in classification, working cooperatively, communicates reasonableness of classification, identifies clock parts, and refers to parts using geometric terms.



Bugs On a Stick *Elementary Level #4*

Materials/Supplies:
Colored/opaque plastic cups
Sticky substances (jelly, honey, Vaseline, peanut butter, white Karo syrup, molasses, etc.)
Electric fence posts or dowels





Topic Strands:
Diversity
Data Analysis

Conceptual Threads:
Scale and Structure
Problem Solving

Process Skills of Learning:
Hypothesizing
Interpreting Data
Predicting
Classifying
Problem Solving
Observing

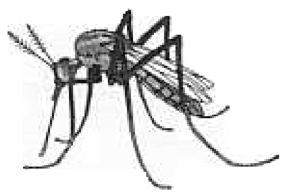
Why (Purpose/Objective of the lesson):
To classify and study insects. This lab also is designed to formulate and test a hypothesis.

How (Procedure of the lesson):
1. Discuss factors which may attract insects.
2. Have students work in small groups to make the insect-collecting device at the left. The class decides a variable to investigate. Possible variables to investigate include: color of container, type of container, type of substance (sticky or otherwise), location of container.
3. Share the assessment rubric with students. Use to the degree applicable for your grade level.
4. One attribute is chosen by students to classify insects. Possible attributes are size, color, or body parts.
5. Discuss appropriate question(s). Which color of cup attracts the most insects? Does the position of the cup affect the number of insects captured? What area of the school has the most insects? What sticky substances work the best? What changes would students make in their experiment?
6. Students graph number of bugs collected by selected variables. Class data is averaged when possible.

For Your Information (Background information for the lesson):
"Bugs on a Stick" is a lab designed to allow students to formulate and test a hypothesis they have proposed. This lab makes a nice closing activity for a unit on the scientific inquiry or a nice introductory lab for a unit on insects.

The objective of the lab is to find a method that will capture insects, Working within their lab groups, students first formulate a hypothesis to test. Raw data are analyzed by graphing and students discuss whether or not their hypotheses are supported, any changes they would make in their experiments, and any sources of error.

Bugs On a Stick *Elementary Level #4*



One way to catch insects is to coat a plastic cup with Vaseline. The best time to do this activity is in early fall.

Suggested Instructional Strategies:
Students will work in small cooperative groups. The teacher acts as facilitator and discussion leader in developing the insect unit.

Additional Activities (Extensions):
1. Use microscope slides with Vaseline on them. Then look at the captured insects under the microscope or with a hand-held magnifier.
2. Illustrate insects as viewed under the microscope.
3. Plot migration paths of selected insects (i.e., killer bees, or monarch butterflies).
4. Investigate uses of insects by cultures throughout the world (i.e., food source, religious rites, or medicine).
5. After catching their "bugs," students could write a poem about a bug they caught.
6. Use dirt cups as an anticipatory set or culminating activity.

DIRT CUPS

1 pkg. 16 oz. chocolate sandwich cookies
2 cups cold milk
1 pkg., 4 serving size, chocolate instant pudding
1 tub, 8 oz., whipped topping
10 clear plastic 7 oz. cups
gummy worms or frogs

Crush cookies in a plastic bag with a rolling pin.
Pour milk in a bowl and add pudding. Mix 1-2 minutes and let stand for five minutes.
3. Stir whipped topping into pudding mixture. Also stir in 1/2 crushed cookies.
4. Put 1 TB. crushed cookies in bottom of 7 oz. cups. Fill cups 3/4 full with pudding mixture. Top the cups with remaining crushed cookies.
5. Refrigerate 1 hour. Decorate with gummy worms or frogs.

Another Approach:
A variety of instructional strategies should be used to accommodate multiple learning styles. Structured activities are important to the development of inquiry and problem-solving skills. As the school year progresses, a natural evolution is to incorporate student-centered activities where the students are actively involved and responsible for their own learning. A student-centered approach to "Bugs On a Stick" follows."

Bugs On a Stick *Elementary Level #4*

A Student-Centered Approach

Topic Strands:	**Conceptual Threads:**
Diversity	Scale and Structure
Data Analysis	Connections, Communications

Why (Purpose/Objective of the lesson):
This open-ended lab is designed to allow students to formulate and test a hypothesis they have proposed.

How (Procedure of the lesson):
1. Brainstorm what they know about insects including how to collect them.
2. Share the assessment rubric with students prior to the activity. Use to the degree applicable for your students.
3. Students design a system that can be used to collect a variety of insects for scientific study.
4. Estimate, count, classify, and graph the number of insects collected. Calculate ratio and percentage of one type of insect to the total population caught. Write math story problems to go with this activity. Examples are located in "For Your Information."
5. Students will complete a written lab which shows evidence of their use of the scientific inquiry and includes the question, hypothesis, materials, procedure, data, results (graphs), and conclusion.
6. Share strategies for collecting insects and what they have learned. How does color, location, or other variables affect insect collection?
7. Students will communicate what has been learned.

Additional Activities (Extensions):
1. Design an insect to flourish in a specific environment of the student's choice. Explain/demonstrate adaptations to the class.
2. These literature selections can be used during and/or following the lesson. Use drama, puppets, student-made books, art activities, or role playing to enhance the literature selections (*The Grouchy Ladybug* by Eric Carle; "The Ant and the Grasshopper," folktale; *The Ladybug and Other Insects Book*, First Discovery Book; *Old Black Fly* by Jim Aylesworth; *How Many Bugs in a Box* by David Carter; or *The Very Quiet Cricket* by Eric Carle).
3. Invite a beekeeper and/or pest control worker to speak to the class.

Bugs On a Stick   Elementary Level #4

Possible Assessment Ideas:
This is an open-ended activity which could be used as an assessment activity for the scientific method.

Assessment Checklist

Demonstrates	Does Not Demonstrate	Behavior
		1. Exhibits evidence of using the five senses for observation purposes.
		2. Records observations in a systematic manner.
		3. Hypothesis is stated clearly and concisely.
		4. List of materials is complete.
		5. Procedure is written clearly so that it can be easily understood and followed.
		6. Data is complete and organized.
		7. Only one variable was manipulated.
		8. Created a graph which clearly represents data collected.

Bugs On a Stick   Elementary Level #4

Outcome: Design and conduct an experiment involving a living organism.

Task: "Bugs On a Stick" design an experiment to collect the most bugs.

Criteria	Proficient	Basic	In Progress
Hypothesizing	Clear, concise statement of the problem.	Problem is stated but needs help with clarity.	Needs a lot of help in writing the problem.
Communicating	Complete list of needed materials. Procedure is written so anyone could duplicate the experiment.	Incomplete list of needed materials. Procedure is written, but one or two steps are left out.	Little or no materials listed. Many steps in the procedure are left out. Experiment could not be duplicated.
Understanding Variables	Only one variable is changed.	More than one variable is changed.	Did not attempt to control any variable.
Measuring (Graphing)	Bar graph with a title and both axes are correctly labeled.	Bar graph is not labeled correctly.	Incomplete bar graph.
Observing	Detailed map of area. Data complete and organized.	Map has details omitted. Data complete but not organized.	No map. Data incomplete and without organization.
Reasoning	Written conclusion is supported by data collected.	Written conclusion is not supported by data collected.	No conclusion.

Magnificent Magnets *Elementary #5*

Materials/Supplies:
Various shapes and sizes of magnets, cow magnets
Paperclips
Cardboard
Markers

Topic Strands:
Force and Motion
Force and Motion
Data Analysis

Conceptual Threads:
Patterns of change
Energy
Problem Solving

Process Skills of Learning:
Communicating
Interpreting Data
Observing
Problem Solving

Why (Purpose/Objective of the lesson):
To demonstrate how forces can be used to make objects interact, move, stop, or change directions.

How (Procedure of the lesson):
1. Teacher shares and discusses a refrigerator magnet with the class.
2. Select six items in the room that are believed to be magnetic.
3. Students test their predictions.
4. Explore what magnets can do.
5. Determine the strengths of the magnets from the strongest to the weakest.
6. Estimate the number of paperclips various magnets will pick up.
7. Construct a class graph and analyze the results.
8. Students will work in small groups to create a magnet game and share their game with others (maze, street scene, racetrack)
9. Estimate, then time the movement through the maze.
10. Discuss how magnets are used in our daily lives.
11. Culminating activity: read *Mickey's Magnet* by Franklyn M. Branley and Eleanor K. Vaughan.

For Your Information (Background information for the lesson):
1. The strength of the magnetic force is dependent upon the materials composing the items being tested.
2. Cow magnets are inserted into cows to prevent barbed wire from damaging their stomachs.
3. Related resources: AIMS - Mostly Magnets, Mudpies to Magnets.

Additional Activities (Extensions):
1. Experiment with iron filings to make patterns. Illustrate, design, and write a statement about why the filings reacted the way they did.
2. Paint a picture using a magnet and paper clip. Place several drops of paint on a piece of paper in a shoebox lid. Place the paper clip in the paint. Create a picture by moving the magnet under the lid.

Magnificent Magnets *Elementary #5*

3. Use a magnet to find objects in a treasure chest (shoe box filled with rice).
4. Write directions and share games with another classroom or grade level.
5. Create a 3-D magnet using a plastic pop bottle of baby oil and iron filings. Fasten a test tube down into the bottle and place a cow magnet in the test tube. Cushion the test tube with a cotton ball. When the cow magnet attracts the filings it will be a 3-D effect.
6. Have students compile a list of items in their home that utilize magnets.
7. Research the history of magnets and find out how they are used in various fields — technology, medicine, and industry — around the world.

Suggested Instructional Strategies:
Students will work cooperatively in small groups.

Possible Assessment Ideas:
Use rubric to assess the creation and completion of magnet game.

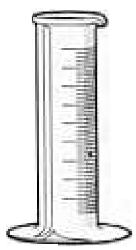
Purpose: Students will demonstrate how force can be used to make objects interact.

Task: Mattel is looking for new games for their Christmas line. Each student is part of a team that is creating a new game using magnets. First, think of ways that magnets can be used. Second, plan a game in which magnets can be used. Third, build the game and plan ways to make it attractive. Each team then tells the class how to play the game.

Criteria	Proficient	Basic	In Progress
Communication	Gives most of the rules of the game.	Gives some of the rules of the game.	Gives no rules for the game.
Cooperative Learning	Listens to others. Takes turns. Encourages others.	Listens occasionally; occasionally takes turns; encourages and puts down the group.	Does not listen to others; does not take turns; puts down others.
Problem Solving	Understands directions; gathers ideas with group; makes a plan for a game.	Directions are not clear; some difficulty gathering ideas; makes a plan with teacher/peer assistance.	Does not understand directions; group has few ideas; no plan for a game.
Product	Demonstrates a clear understanding of magnetic strength and magnetic poles.	Makes some attempt at demonstrating magnetic strength; some understanding of the magnetic poles.	Demonstrates no progress in the understanding of magnetic force in their game.

Rising to the Top *Elementary #6*

Materials/Supplies:
Graduated cylinders
Various objects that will sink or float
Book: *Mr. Archimedes Bath*
Clay
Balance scales
Weights



Topic Strands:
Number Sense
Data Analysis
Matter

Conceptual Threads:
Connections
Problem Solving
Systems and Interactions

Process Skills of Learning:

Observing	Problem Solving	Predicting
Communicating	Interpreting Data	Measuring

Why (Purpose/Objective of the lesson):
To demonstrate, observe, collect data, predict, and communicate that matter occupies space and has weight.

How (Procedure of the lesson):
1. Read *Mr. Archimedes' Bath* by Pamela Allen.
2. Students work in small groups to predict and explore the rising of water using a variety of objects.
3. Experiment by placing various objects into a graduated cylinder or beaker filled with water.
4. Collect data during exploration. Record data.
5. Predict the object's mass.
6. Use a balance scale and weights to explore and compare weight, volume, and size of the objects.
7. Collect and record data.
8. Graph results with mass on vertical axis and volume on horizontal axis.

For Your Information (Background information for the lesson):
1. Flexible plastic cylinders are better than glass or hard plastic because they are less likely to crack or break.
2. If graduated cylinders are not available, use a clear plastic cup and establish marks using a non-standard "unit." Objects should be large enough to raise water at least 1 unit.
3. The amount of water displaced will be the volume of the object. The difference between the weight of the object in the air and the weight in the water will be close to the volume of the object.
4. Younger students may be more successful if beakers are used instead of graduated cylinders.
5. Clay is essential to have available as one of the various objects for the comparison of size and mass. Use clay to create similar-shaped objects with different masses or similar-massed objects with different shapes to lead students to discover that it is not mass that displaces water but the volume of the objects.
6. A reference book is AIMS *Floaters and Sinkers*.

Rising to the Top *Elementary #6*

Additional Activities (Extensions):

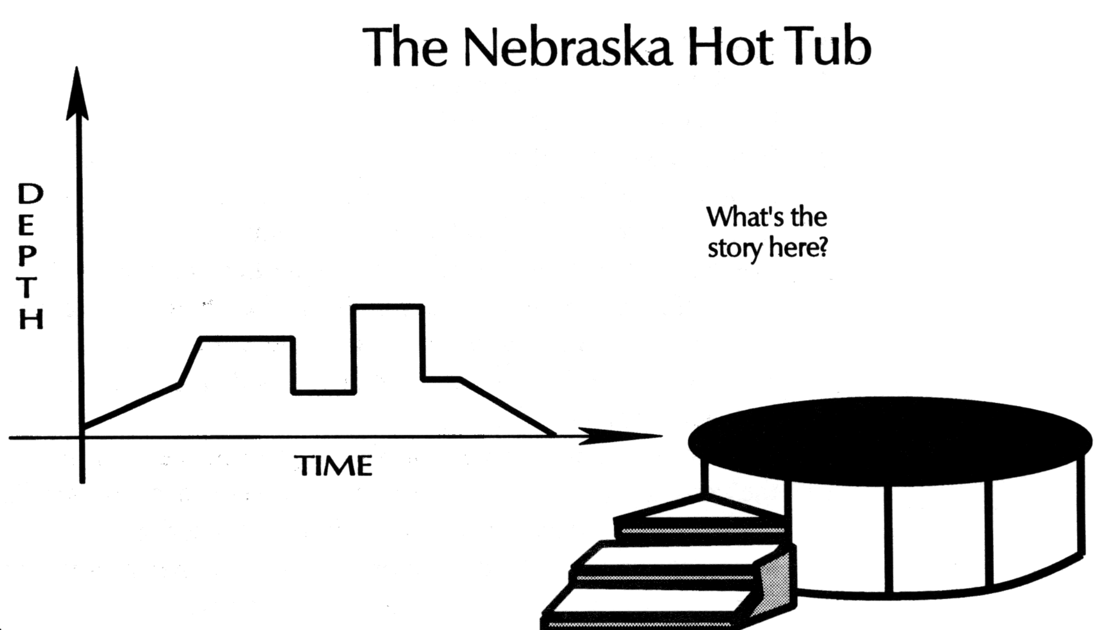
1. Use various-sized, marshmallow-filled containers to experiment with volume.
2. Substitute various liquids such as oil, soap, or salt water for the water.
3. Experiment with larger objects such as fruits and vegetables, regular soda and diet soda to see what will sink and float.
4. Use three film canisters containing 14, 7, and 0 pennies, respectively. Predict whether they will sink or float. Experiment and record observations. Explain results. (*Super Science Blue*; April, 1995; Scholastic Magazine).
5. Make a clay boat. Estimate the number of paper clips the boat will carry before sinking. Test prediction.
6. Research history of water transportation and how it is used in other cultures.

Suggested Instructional Strategies:

1. Students work cooperatively in small groups of 3-4.
2. All students will be involved in exploration.
3. Teacher acts as a facilitator using questioning strategies to enhance inquiry.

Possible Assessment Ideas:

1. Graph findings.
2. Write a story to explain the Nebraska Hot Tub graph.



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